CLAIMS

1. An apparatus comprising:

an optical die flip-chip bonded to a substrate and defining a volume between the optical die and the substrate, the optical die including an optically active area on a surface of the die facing the substrate;

an optically transparent material occupying at least those portions of the volume substantially corresponding with the optically active area; and

an underfill material occupying portions of the volume not occupied by the optically transparent material.

2. The apparatus of claim 1 wherein the optically active area is a detector or a source.

3. The apparatus of claim 1 wherein the optically transparent material has a low modulus of elasticity.

4. The apparatus of claim 1 wherein the optically transparent material is optically transparent at wavelengths between 800 nm and 1550 nm.

5. The apparatus of claim 4 wherein the optically transparent material is optically transparent at a wavelength of approximately 850 nm.

6. The apparatus of claim 1 wherein the optically transparent material has a refractive index of approximately 1.5.

7. The apparatus of claim 1 wherein the optically transparent material is an adhesive.

8. The apparatus of claim 7 wherein the optically transparent material is silicone-based.

9. An apparatus comprising:

an optical die flip-chip bonded to a substrate and defining a volume between the optical die and the substrate, the optical die including an optically active area on a surface of the die facing the substrate;

an optical component partially positioned in the volume between the optical die and the substrate to carry an optical signal to or receive an optical signal from the optically active area;

an optically transparent material occupying those portions of the volume substantially between the optically active area and the optical component; and

an underfill material occupying portions of the volume not occupied by the optically transparent material and the optical component.

10. The apparatus of claim 9 wherein the optical component is a waveguide.

11. The apparatus of claim 9 wherein the optically active area is a detector or a source.

12. The apparatus of claim 9 wherein the optically transparent material has a refractive index substantially the same as a refractive index of the optical component.

13. The apparatus of claim 9 wherein the optically transparent material has a refractive index of approximately 1.5.

14. The apparatus of claim 9 wherein the optically transparent material has a low modulus of elasticity.

15. The apparatus of claim 9 wherein the optically transparent material is optically transparent at wavelengths between 800 nm and 1550 nm.

16. The apparatus of claim 15 wherein the optically transparent material is optically transparent at a wavelength of approximately 850 nm.

17. The apparatus of claim 9 wherein the optically transparent material is an adhesive.

18. The apparatus of claim 9 wherein the optically transparent material is silicone-based.

19. A system comprising:

a signal source;

a first optical die coupled to the signal source, the first optical die being flip-chip bonded to a substrate and defining a first volume between the first optical die and the substrate, the first optical die including an optically active area on a surface of the die facing the substrate;

a signal destination;

a second optical die coupled to the signal destination, the second optical die being flip-chip bonded to a substrate and defining a second volume between the second optical die and the substrate, the second optical die including an optically active area on a surface of the die facing the substrate;

an optical component extending between the first and second optical dies, the optical component partially positioned in the first and second volumes;

an optically transparent material occupying those portions of the first and second volumes substantially between the optically active areas and the optical component; and

an underfill material positioned in the portions of the first and second volumes, the underfill material occupying portions of the volume not occupied by the optically transparent material.

20. The system of claim 19 wherein the optical component is a waveguide.

21. The system of claim 19 wherein the optically active area of the first die is a source and the optically active area of the second die is a detector.

22. The system of claim 19 wherein the optically transparent material has a refractive index substantially the same as a refractive index of the optical component.

23. The system of claim 19 wherein the optically transparent material has a refractive index of approximately 1.5.

24. The system of claim 19 wherein the optically transparent material has a low modulus of elasticity.

25. The system of claim 19 wherein the optically transparent material is optically transparent at wavelengths between 800 nm and 1550 nm.

26. The system of claim 25 wherein the optically transparent material is optically transparent at a wavelength of approximately 850 nm.

27. A process comprising:

flip-chip bonding an optical die to a substrate, the optical die including at least one optically active area on a surface thereof facing the substrate;

dispensing an optically transparent material between the optical die and the substrate, wherein the optically transparent material covers the at least one optically active area;

dispensing an underfill material in the volume between the optical die and the substrate not occupied by the optically transparent material; and

curing the optically transparent material and the underfill material.

28. The process of claim 27 wherein curing the optically transparent material and the underfill material comprises simultaneously curing the optically transparent material and the underfill material.

29. The process of claim 27 wherein curing the optically transparent material and the underfill material comprises first curing the optically transparent material and then curing the underfill material.

30. The process of claim 27 wherein curing the optically transparent material and the underfill material comprises first curing the underfill material and then curing the optically transparent material.

31. The process of claim 27 wherein the optically transparent material can be fully cured at temperatures less than or equal to 180 °C.

32. The process of claim 27 wherein the optically active area is a detector or a source.

33. The process of claim 27 wherein the optically transparent material has a low modulus of elasticity.

34. The process of claim 27 wherein the optically transparent material has a refractive index of approximately 1.5.

35. The process of claim 27 wherein the optically transparent material is an adhesive.

36. The process of claim 27 wherein the optically transparent material is silicone-based.

37. A process comprising:

flip-chip bonding an optical die to a substrate, the optical die including at least one optically active area on a surface thereof facing the substrate;

inserting at least part of an optical component between the optical die and the substrate to carry an optical signal to or receive an optical signal from the optically active area;

dispensing an optically transparent material between the optical die and the optical component, wherein the optically transparent material occupies at least the volume between the optically active area and the optical component;

dispensing an underfill material in the volume between the optical die and the substrate not occupied by the optically transparent material; and

curing the optically transparent material and the underfill material.

38. The process of claim 37 wherein the optical component is a waveguide.

39. The process of claim 37 wherein curing the optically transparent material and the underfill material comprises simultaneously curing the optically transparent material and the underfill material.

40. The process of claim 37 wherein curing the optically transparent material and the underfill material comprises first curing the optically transparent material and then curing the underfill material.

41. The process of claim 37 wherein curing the optically transparent material and the underfill material comprises first curing the underfill material and then curing the optically transparent material.

42. The process of claim 37 wherein the optically transparent material can be fully cured at temperatures less than or equal to 180 °C.

43. The process of claim 37 wherein the optically active area is a detector or a source.

44. The process of claim 37 wherein the optically transparent material has a low modulus of elasticity.

45. The process of claim 37 wherein the optically transparent material has a refractive index substantially the same as a refractive index of the optical component.

46. The process of claim 45 wherein the optically transparent material has a refractive index of approximately 1.5.